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ABSTRACT

This paper describes a project meant to develop a standard for Hong Kong students' work in biology. The process involves defining students' work and setting standards for students aged 9, 12, and 16. Besides defining the academic and scientific knowledge to be achieved at various levels, the analysis also includes desirable skills and attitudes for students learning science. Both science process and cognitive skills are included in the portrait of students' work. The role of teachers who participated in the study and ways to enhance professional development among them is also discussed. (Author/WRM)

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Abstract

This project aims to develop a standard of students' work in Biology. The process involves defining students' work and setting standards at age 9, 12 and 16. Besides defining the academic scientific knowledge to be achieved at various levels, the analysis also includes skills and attitudes of the students in science learning. Both science process and cognitive skills are included in the portrait of students' work. Finally, the paper describes the role of teachers who participate in the study and ways to enhance professional development among them.

Background

Students' achievement in Science in Hong Kong

The Board of Education's Report on Review of 9-year Compulsory Education (1997) has reflected that overall student learning was unsatisfactory in Hong Kong. In particular, students' achievement in science is problematic as reflected by recent international studies. An international comparison on students' achievement in Science and Mathematics, the third International Mathematics and Science Study (TIMSS) has shown that science achievement was much lower than mathematics achievement among primary pupils in Hong Kong. For mathematics, 18% of the pupils from Hong Kong score among the top 10% of the fourth graders (primary 4-5) in the 26 TIMSS countries. For Science, only 4% of the pupils score among the top 10% (Law, 1997). Unlike most of the countries where the achievements in Mathematics and Science are closely related (Singapore, Korea, Japan and Belgium), Hong Kong ranked fourth and twenty-fourth for the two subjects respectively. The contrast in Hong Kong points to a potentially disturbing situation.

With the introduction of the General Studies (GS) curriculum, teachers are requested to integrate the teaching of science in thematic units. The integration and the emphasis are largely dependent on the knowledge and attitude of individual teachers. A recent study (Cheng, So and Tsang, 1997) has found that more than 70% of the teachers teaching GS are in the Arts stream in their secondary education. While the TIMSS results for the Hong Kong primary level is not as satisfactory for Science compared with Maths, the results at the

secondary two level is more disappointing. Only the top 5% of the secondary two students are comparable with the performance of the top 25% of Singaporean students. Hong Kong's result is also significantly lower than other developed countries participating in the study e.g. Singapore, Japan, Korea, England, United States and Canada. Combining the two evidences, the science attainment of the secondary two students can partly reflect the academic background of the teachers who were in the Arts stream as they have stopped taking any more science content after secondary three. It is not surprising to find that teachers expressed much concern and worry over the teaching of the science content in the GS curriculum (So, Cheng and Tsang, 1998). In the study, 19.5% of the respondents reported that the school principals have arranged more than one teacher teaching one class in GS. This may lessen the anxiety of the teachers but may lower the effectiveness in making GS an integrated subject.

The above research results suggest that science learning for primary pupils in Hong Kong warrants closer attention. Science education is described as "an important part of children's educational experience" (Loucks-Horsley et.al., 1990). Science education is recognised as a part of basic education as well as an essential part for producing scientifically literate adults. Educating scientific literate citizens is an agenda of top priority in the United States (AAAS, 1989). To achieve this goal, science in the primary school is seen as the foundation of future learnings. It is a time when attitudes, interest and confidence in learning science are developed. While the science achievement of primary pupils in Hong Kong is low, it is time that our society should invest more resources in improving science education.

This paper describes the construction of the framework of a project that focuses on the study of pupils' work. The aim is to portrait the performance standards of the pupils in Biology topics at age 9, 12 and 16. A list of Biology topics to be covered in the project is shown in Table 1. Their performance is not represented in numbers or scores but descriptions of how the pupils have been doing at the average level, below and above average levels. This will give the teachers much insight about how to set their expectations for pupils' performance. The teachers are directly and actively involved in the study instead of being test administrators. The teachers who participate in the study will also be able to reflect on their own science teaching, share their experiences with other local teachers and teachers from other parts of the world.

The framework of the project

The Study of Students' Work in Biology

This project is structured with an aim to develop a standard of students' work in Biology. The standard includes the definition of what is meant by at the average level, above and below average level. The excellence at issue is excellent student work. At each level, the students' attainment in terms of knowledge, science process and cognitive skills are defined. The aims are two folds: set performance standards for selected Biology topics at the primary and secondary levels; and to improve the teaching and learning of science in Hong Kong.

In order that teachers can participate in the project and hold meaningful discussions about students' work, a series of workshops are to be arranged. The strategy is to teach teachers how to collect, analyze, and present student work samples that will serve as the basis of professional discussion with peers. Two main questions are addressed: " How good is good enough?" and "How do you get all students to produce world-class work?" The workshops include discussions about results of international studies on student achievement, different methods of studying student achievement, defining students' work, setting teaching objectives for science and setting expectations of students' performance. Teachers analyze samples of students' work and experiment with setting objectives, expectations and comments on the samples. Teachers also share their experience in teaching science topics with teachers from other schools in the workshops. After the workshops, it is expected that the teachers will have a clear understanding of the aims of the project, what is meant by students' work and how to set objectives and expectations for students' work.

After the workshops, the teachers then start to collect samples of students' work that are representative of the three levels of achievement. Sharing sessions with teachers are to be held after each round of collection of students' work. During these sessions, teachers will share their expectations and comments with teachers from other schools. Through these discussions, teachers will have more understanding about the teaching and learning of Biology in other schools.

An International Network of Teachers

Besides setting a local standard, this project has taken an innovative approach by participating in world-wide project Schools Around the World (SAW) which was initiated in the United States by an education research foundation, Council for Basic Education (CBE). The affiliation with the international project gives the advantage of the setting up a professional network of teachers internationally. In the network, teachers can work together to develop not only the local set of standard but also world-class expectations for students. The teachers network is to sustain an on-going dialogue about whether the work represents

high student achievement and what it takes to support students in the pursuit of that achievement. This model invites teachers across national boundaries to teach one another how to create learning environments and challenging teaching relationships that invite students to high levels of achievement.

The development of the technology is necessary to support teachers' communication within and across boundaries of countries. Students' work, comments as well as expectations of teachers and associate teachers are to be digitized. The digitization of these materials allows them to be placed on the web site maintained by the international steering committee. Teachers will thus be able to assess to such information from any parts of the world. For teachers without reasonable bandwidth to accommodate the speed required to assess images on the Internet, they will have to rely on the use of CD Roms to provide such information. It is therefore necessary for the project team to place the content in the website into CDs such that these teachers can have assess to the information as if they are placed on the Internet. The creation of a listserve for all the teachers allows the exchange of ideas. These facilitate the communication among the teachers locally and with teachers in other parts of the world.

As teachers are engaged in professional discussion about the nature of excellence and the methods of teaching, their professional competence is enhanced. Through setting a standard for Biology learning, the opportunity for teachers' professional development is created and this will eventually enhance student learning in Biology. The outcome is that it develops the teachers' knowledge of alternative pedagogies, sharpen their analysis of student performance, assist in setting new standards, targets, promote awareness of teaching and learning opportunities using Information and Communications Technology, and help them to work within an international dimension. The outcomes related to the professional development of teachers are therefore:

- A professional development template, including administrators as well as seminar outlines for their use, for teaching teachers how to conduct the research necessary to produce samples of student work with commentary, as well as how to use work samples as the basis for analyzing and improving their teaching.
- A facilitated set of discussions aimed at providing professional development that helps teachers to learnt to articulate their expectations, raise them, and learn what they can do to improve the chances that all of their students will meet them.
- A groundbreaking use of technology to connect teaching peers from around the world, which will demonstrate what technology has to offer to professional development efforts, as well as the limits of current technology for such work.

Setting Standard of Students' work in Biology

Based on the students' works collected, teachers' expectations and comments, the researchers can establish a set of standard for Biology learning at the selected levels. For each Biology topic, there will be a set of expectations for students with high, low and average achievement levels. In order to portrait a more concrete picture of students' achievement, the standard are to be exemplified with samples of students' works. The first draft of the standards is to be sent to local educators for their consultation and a forum will be held for teachers. These will serve to collect the views from the researchers or academics in the field as well as that from the practitioners. The forums are also to be open to teachers that are not previously involved in the project. The forum will serve to introduce to a larger population of teachers about the standards and collect feedback or suggestions from the audience. Drawing together the views of local educators and primary teachers, the draft of standards is to be revised. Eventually, the standard of student learning in Biology set in this project include:

- A standard of student achievement in Biology for the local community.
- A unique international collection of student work samples, produced according to the same protocol among participating sites (including commentary from teachers and rich contextual descriptions)—available on CD-ROM and website.

This set of standards will be shared with other participating countries in the SAW project. The standards together with the samples for illustration are to be published in a booklet and disseminated to all the local Biology teachers.

Evaluation

The evaluation of the project is to be mounted by 3 steering committees both at the local and the international level. The local level includes two committees as follows:

- The National Steering Committee which include officers from the Department of Education;
- The Project Management Team, members include 2 teacher representatives from the participating primary schools and 2 teacher representatives from the participating secondary schools;

These committees are set up to continually monitor the progress of the project.

The international level involves the International Steering Committee and the membership includes representatives from different countries participating in the SAW project. The countries include: Australia, Czech Republic, Germany, Hong Kong, Japan Portugal, United Kingdom and the United States. The international committee is to

oversee all the participating nations in their use of technology that fosters teacher communication and the overall progress of the project.

The major variable to be evaluated includes:

1. The standard of students' work in the specified areas in Biology.
2. The development of teachers' professional competence through the setting up of students' learning.

The measurement of the second variable, students' work standard in specified areas in Biology is to be made qualitatively. The standard developed is to be made known to science educators, inspectors, school practitioners, school heads and teachers and they are invited to comment on the standard. The Hong Kong standard will be set having taken into account the comments and with the consensus of 50% or more of the consultants. The Hong Kong standard is open for discussion internationally and further comments will be received. The standard will next be modified taking into account the comments from other countries.

The measurement of the first variable is made by the administration of a quantitative instrument. An instrument that measures teacher professional competence is to be constructed and pilot tested. In phase 2 of the project, the instrument is to be administrated before the workshops for the participating teachers and at the completion of the project. The same scale is to be implemented in all the other participating countries in the SAW project such that a comparison of the development of teacher professional competence across different countries can be made. The findings of the evaluation are to be discussed among the countries. If 70% or more of the teachers reflected a significant difference in their perception of professional competence, the project is deemed to be successful in achieving its aim.

Conclusion

This paper has described a framework to study the standard of students' work, which is quite different from the administration of standard tests to find out students' achievement. While pupils are asked to respond to a set of common questions in the study, little about the learning context can be reflected nor can the study inform teachers about what is meant by a high score in the standard test. In addition, the school and the social context can influence science learning in school. To make more meaning from the comparisons, better understanding about the learning context and descriptions for the standards are needed. For local teachers, the present framework with the international component addressed the additional question that is whether science achievement effected through this integrated

curriculum is comparable to international standards.

The framework has been designed with three purposes in mind. Firstly, to describe explicitly a standard for Biology learning locally and comparing this standard with other countries. Secondly, to help our teachers understand the local learning context for Biology among different schools locally as well as in schools of other countries. Thirdly, participation in the project allow teachers to share and discuss about Biology learning with local teachers and teachers in other countries thus effecting professional development. The outcome on professional development is important such that this ensures a change in the quality of teaching and learning in the school. It is this part that makes the setting of standards of learning or other international attempt to compare students' achievement meaningful. Moreover, this model of setting standards in Biology learning can be expanded to other areas of learning in science or even to other discipline areas with an aim for professional development of teachers that leads eventually to an improved quality of learning.

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Table 1 List of Biology topics to be covered at age 9, 12 and 16 in Hong Kong

Age	Topic
Age 9	Air and organisms, Reproduction of animals and plants
Age 12	Living things and Air; Sensing the environment
Age 16	Development of organisms and continuity of life; Inter-relationship of organisms with each other and with the environment